U.S. DEPARTMENT OF PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER

JC12 Rec'd PCT/PTO 18 SEP 2001

U.S. APPLICATION NO. (if known)

09/936873

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/SE 00/00487	March 13, 2000	March 18, 1999

TITLE OF THE INVENTION

Device for Generating Mechanical Vibration

APPLLICANT(S) FOR DO/EO/US

Ulf Andersson

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is the **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is the **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2))
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

    1. Six (6) sheet(s) of drawing.
    2. Form PCT/RO/101
    3. Form PCT/ISA/210
    4. Form PCT/ISA/220
    5. Form PCT/IPEA 401
    6. Form PCT/IPEA/409

16a. ☒ Applicant is a Small Entity.

U.S. APPLICATION NO. (if known)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/936873	PCT/DE 00/00487	ULFIA-1

17. [X] The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO.....$860.00	$860.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....$710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO.....$1,000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		

Claims	Number Filed	Number Extra	Rate		
Total Claims	4 - 20 =	0	X $18.00		
Independent Claims	1 - 3 =	0	X $80.00		
Multiple dependent claim(s) (if applicable)			+ $270		

TOTAL OF ABOVE CALCULATIONS =	$860.00	
Reduction by 1/2 for filing by small entity, if applicable. (Note 37 CFR 1.9, 1.27, 1.28).	-$430.00	
SUBTOTAL =	$430.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).		
TOTAL NATIONAL FEE =	$430.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +		
TOTAL FEES ENCLOSED =	$430.00	
	Amount to be refunded	
	charged	

a. [X] A check in the amount of $430.00 to cover the above fee is enclosed.

b. [ ] Please charge my Deposit Account No. 15-0773 in the amount of $860.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 15-0773. A duplicate copy of this sheet is enclosed.

Note: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Walter Ottesen
Patent Attorney
P.O. Box 4026
Gaithersburg, Maryland 20885-4026

SIGNATURE

Walter Ottesen
NAME

25,544
REGISTRATION NUMBER

Form PTO-1390 (REV 5-93)

In the United States Patent and Trademark Office

In re patent application of: Ulf Andersson

International Application No: PCT/SE 00/00487 filed on March 13, 2000

Priority Claimed: Swedish patent application 9900990 filed on March 18, 1999

Title of Invention: Device for Generating Mechanical Vibration

Attorney Docket: ULFIA-1

Preliminary Amendment

Honorable Commissioner of
Patent and Trademarks
Washington, D. C. 20231

Dear Sir:

Please amend the above-identified application as delineated below.

In the Disclosure:

On page 1, line 5, please insert:

-- Field of the Invention --.

On page 1, line 8, please insert:

-- Background of the Invention --.

On page 2, line 54, please insert:

-- Summary of the Invention --.

On page 2, please delete line 57 and substitute therefor the following:

-- The arrangement of the invention is for generating a mechanical vibration including: a mass; first and second force cells for generating first and second rotating force vectors to form a resultant force acting on the mass to impart mechanical vibration thereto; the first force cell including a first rotating eccentric to generate the first rotating force vector; an electrically controlled first drive for rotating the first rotating eccentric; and, a first angle sensor for detecting the angular position of the first rotating eccentric relative to a reference direction and outputting a first signal indicative thereof; the second force cell including a second rotating eccentric to generate the second rotating force vector; an electrically controlled second drive for rotating the second rotating eccentric; and, a second angle sensor for detecting the angular position of the second rotating eccentric relative to the reference direction and outputting a first signal indicative thereof; and, the electrically controlled first drive being separate from the electrically controlled second drive.

Brief Description of the Drawings

The invention will now be described with reference to the drawings wherein:

FIG. 1 is a block diagram of an embodiment of the arrangement of the invention for generating a mechanical vibration;

FIG. 2 shows two views of the arrangement of the invention for generating mechanical vibrations;

FIG. 3 is a more detailed schematic of the arrangement of the invention equipped with two force vector cells;

FIG. 4 presents three vector diagrams showing the amplitude of the rotating force vector for a phase difference between eccentrics of 0°, 135° and 180° in an arrangement of the invention having two force vector cells;

FIG. 5 presents a force vector with adjustable direction and fixed amplitude and showing how displacing the phase position 0°, 90° and 45° in relation to the reference direction can rotate the force vector;

FIG. 6 presents a force vector with adjustable direction and fixed amplitude; and,

FIGS. 7A and 7B show vector diagrams for a vibration system having three force vector cells wherein the eccentrics 1 and 3 rotate in the same direction and eccentric 2 rotates in the direction opposite thereto.

Description of the Preferred Embodiments of the Invention --.

On page 8, line 223, please delete "SUMMARY:" and substitute therefor:

-- Abstract of the Disclosure --.

In the Claims:

Please cancel claims 1 to 4 and add claims 5 to 8 as follows:

5. An arrangement for generating a mechanical vibration

comprising:

a mass;

first and second force cells for generating first and second rotating force vectors to form a resultant force vector acting on said mass to impart mechanical vibration thereto;

said first force cell including a first rotating eccentric to generate said first rotating force vector; an electrically controlled first drive for rotating said first rotating eccentric; and, a first angle sensor for detecting the angular position of said first rotating eccentric relative to a reference direction and outputting a first signal indicative thereof;

said second force cell including a second rotating eccentric to generate said second rotating force vector; an electrically controlled second drive for rotating said second rotating eccentric; and, a second angle sensor for detecting the angular position of said second rotating eccentric relative to a reference direction and outputting a second signal indicative thereof; and,

said electrically controlled first drive being separate from said electrically controlled second drive.

6. The arrangement of claim 5, wherein:

said first force cell including a first control and monitoring device connected to said first angle sensor for receiving said first signal;

said second force cell includes a second control and monitoring device connected to said second angle sensor for receiving said second signal;

a primary control unit connected to said first and second control and monitoring devices;

said primary control unit functioning to generate first and second control signals for setting a rotational frequency, direction of rotation and phase position for said first and second force cells, respectively;

said first control and monitoring device receiving said first control signal and functioning to calculate the direction of rotation, speed of rotation and phase position of said first rotating eccentric based on said first signal and to then generate a first drive signal for said first drive to regulate the direction of rotation, speed of rotation and phase position thereof; and,

said second control and monitoring device receiving said second control signal and functioning to calculate the direction of rotation, speed of rotation and phase position of said second rotating eccentric based on said second signal and to generate a second drive signal for said second drive to regulate the direction of rotation, speed of rotation and phase position thereof.

7. The arrangement of claim 5, said primary control unit having an input for receiving a control signal indicative of parameters for a specific force vector diagram and functioning to determine the direction of rotation, speed of rotation and phase position of each of said first and second rotating eccentrics based on said parameters.

8. The arrangement of claim 5, wherein said first and second rotating eccentrics are rotatably journalled to conjointly define a common geometric axis of rotation and said first and second rotating eccentrics have a mass center whose axis of rotation corresponds to said axis of rotation and rotates in approximately the same geometric plane.

Remarks

Claims 5 to 8 have been added and claims 1 to 4 are canceled so that claims 5 to 8 are pending in this application of which only claim 5 is in independent form. The new claims make improvements as to the form of the original claims.

The disclosure has been amended to add appropriate headings and to incorporate the subject matter of claim 5 to provide a summary of the invention.

Respectfully submitted,

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Date: September 18, 2001

DEVICE FOR GENERATING MECHANICAL VIBRATION.

The invention presented concerns a device for generating mechanical vibration, intended primarily for dynamic compaction of various sorts of material.

For compacting various materials, e.g., in the construction of roads, airfields, vibratory compaction equipment is used to increase the compaction capacity and optimise the result of the compaction work.
Optimisation can consist, for example, of increasing the density of the material, increasing its bearing capacity, achieving a certain density profile with regard to depth and of obtaining a particular surface structure.
The equipment used can, for example, be rollers that have one or more vibrating drums, self-propelled vibratory plates, vibratory pokers and tampers.

To create the vibration, various types of mechanical systems having rotating eccentrics that utilise centrifugal force are used. This gives in space a rotating circular force vector and in time a sine shaped force vector in a certain direction.

To optimise compaction with regard to properties of the compacted material it is necessary that the vibration be given varying frequency, amplitude and direction.

Known vibratory devices with rotating eccentrics alter parameters of the force vector in the following way:

Examples of systems with one eccentric for achieving a circular force vector with variable amplitude:

See, US-patent 5,618,133 Vibrating mechanism and apparatus for generating ...
US-patent 4,342,523 High-low force amplitude device
US-patent 4,221,499 Vibratory device
US-patent 3,966,344 Adjustable vibratory roller

Amplitude of the vibration is changed in that the centre of mass for the eccentric weight is displaced in relation to the rotation centre of the eccentric.
The vibration frequency is set with the speed of rotation of the rotating eccentric.
This is achieved at present by some type of mechanical system.

Systems with two eccentrics:
See US-patent 5,797,699 Process and apparatus for dynamic soil compaction.
A linear force vector is obtained by the two eccentrics rotating in different directions of rotation and fully synchronised, ie, at the same speed of rotation.
By phase displacement of the eccentrics so that the direction is changed as the eccentrics pass each other, the force vector can be controlled to act in varying directions.
Phase displacement of the eccentrics is made by a mechanical system.
Vibration frequency is set with the speed of rotation of the rotating eccentrics.

Characteristic for present vibration systems is that they only permit some specific form of vibration and that complicated mechanical devices are required.

The object of the invention presented is to optimise compaction with consideration to many different types of material being compacted using one and the same device.

Figure 1 and 2 are schematic drawings of the device and figure 3 is a form of execution.

The invention is characterised thereby, in that the generation of vibration is made by a system 1 of two or more so-called force vector cells 2 and where a rotating eccentric 10 in each force vector cell generates a circular rotating force vector.
All force vector cells 2 generate a force vector that acts in the form of a resulting force vector on the common mass 3.
Each eccentric 10 is rotated by a separate electrically controlled drive 11, e.g., electric motor, hydraulic motor, and where the angular position of each eccentric in relation to a reference direction is measured by an angle sensor 12 with electric output signal 9.

Rotation of each eccentric with regard to rotation frequency, direction of rotation and phase position is controlled by a control and monitoring system 5 by a control signal 8 to the drive 11.

With control signal 6, a superior control device 4 determines signal 7, containing a rotation frequency, a direction of rotation and a phase position for each force vector cell 2 to achieve a determined resulting force vector diagram.
The control devices 4 and 5 are at present based on microcomputers for advanced control and monitoring and simple re-programming of the vibration characteristics.

By choosing a suitable number of eccentrics 10, centrifugal force of the eccentrics, frequency, direction of rotation and phase position, it is possible to generate a force vector diagram of suitable form, in space and time.

With one and the same configuration of force vector cells 2, many different types of force vector diagrams can be obtained.
The form of the resulting dynamic force vector diagram can easily be optimised with regard to factors such as the degree of compaction, direction of movement of the compacting appliance and the static force vector from the mass of the appliance.
The invention also allows the force vector diagram to be "modulated" by varying the speed of rotation and phase position of the eccentrics in time.
For the compacting of certain types of material, optimisation can be achieved since the vibration is composed of several different frequencies (multi-frequency vibration).
The invention described also allows an existing apparatus to be easily "re-programmed" to conform to force vector diagrams that have been tested and to new types of material that need to be compacted.

See figure 4–7 for some typical force vector diagrams that can be achieved:

Figure 4: Circular force vector diagram with adjustable amplitude:

The vibration system consists of two force vector cells, where the eccentrics rotate in the same direction and at the same rotational speed and where the phase difference can be regulated.

This results in a circular force vector with amplitude that is adjustable between 0 and maximum depending on the phase difference between the eccentrics.

The figure shows amplitude of the rotating force vector for the phase differences 0, 135 and 180°.

Figure 5: Force vector with adjustable direction and fixed amplitude,

The vibration system consists of two force vector cells, where the eccentrics rotate in opposite directions and at the same rotational speed and where their phase position can be regulated.

This results in a linear force vector that acts in one direction only (+/-) and at fixed amplitude. Direction of the force vector depends on when the centrifugal forces of both eccentrics interact in one direction for each revolution.

The figure shows how displacing the phase position 0, 90 and 45° in relation to the reference direction can turn the force vector.

Figure 6: Force vector with adjustable direction and fixed amplitude,

The vibration system consists of two force vector cells, where the eccentrics rotate in opposite directions and where eccentric 2 rotates at double the rotational speed compared to eccentric 1.

By giving eccentric 2 different phase positions a force vector diagram with different combinations of depth and surface effect can be obtained.

Figure 7A:

The vibration system consists of three force vector cells, where the eccentrics 1 and 3 rotate in the same direction and eccentric 2 in the opposite direction

Speed of rotation for eccentric 1 = 4 Hz, eccentric 2 = 8 Hz, eccentric 3 = 12 Hz.

Amplitude of eccentric 1 = 0.5, eccentric 2 = 0.41, eccentric 3 = 0.18.

With these settings a force vector that acts in depth for a short period is obtained.
Changing the phase position of the eccentrics turns the direction.

Figure 7B:
The vibration system consists of three force vector cells, where the eccentrics 1 and 3 rotate in the same direction and eccentric 2 in the opposite direction.
Speed of rotation for eccentric 1 = 4 Hz, eccentric 2 = 8 Hz, eccentric 3 = 12 Hz.
Amplitude of eccentric 1 = 0.5, eccentric 2 = 0.5, eccentric 3 = 0.5.
With these settings a force vector is obtained that has combined surface and depth effect.
Changing the phase position of the eccentrics turns the direction.

The execution form according to figure 3 is a device with two force vector cells 2a, 2b, where the eccentrics have coaxial location. This implies that the outer eccentric 10a rotates round the inner eccentric 10b. This location means that the mass centre (centre of gravity) of the eccentrics has the same axis of rotation 17 and the same rotation plane 18, which is of significance for the resulting force vector for both of the eccentrics.
The axles 14a and 14b are carried by a number of bearings 16 so that they can rotate freely in relation to one another and to the holder 15.
The principle of coaxial located eccentrics can also be used for 3 or more eccentrics.
The cells are mounted on a common plate 3 the mass of which shall vibrate to compact the underlying material.
The eccentrics 10a, 10b rotate with the respective axle 14a and 14b, which are common for the respective electric motor 11a, 11b and respective angle sensor 12a, 12b.
The motor 11a, 11b is fed from the control device 5a, 5b by a voltage 8a, 8b that determines the direction and speed of rotation for the axle 14a, 14b.
From angle sensor 12a, 12b a signal 9a, 9b is given that is the angle value of the eccentric 10a, 10b in relation to a reference direction which, for example, can be in the horizontal plane.
The signal 7a, 7b from the control device 4 is the desired value for the direction of rotation, speed of rotation and phase position for the eccentric 10a, 10b.

From the signal 9a, 9b from the angle sensor 12a, 12b the control device 5a, 5b calculates the value of the real direction of rotation, speed of rotation and phase position for the eccentric 10a, 10b. Consequently, these values form the actual value of the control system.

The control device 5a, 5b regulates with the voltage 8a, 8b the electric motor 11a, 11b so that the desired value and the actual value are the same.

The signal 6 gives the parameters for the operational case to the control device 4. The parameters can for example be the frequencies for the vibration, form of the force vector diagram and modulation.

PATENT REQUIREMENTS

1. Device for generating mechanical vibration with rotating eccentrics (10) characterised by a system (1) with two or more force cells (2) with rotating force vectors, where the resulting force vector of all force cells acts on a mass (3) and where each force cell (2) consists of a rotating eccentric (10) driven by a separate electrically controlled drive (11) that is mechanically coupled to an angle sensor (12) for measuring the angular position of the respective eccentric in relation to a reference direction.

2. Device according to requirement 1 characterised by a superior control device (4) giving a signal (7) to a separate control and monitoring system (5) for each force cell for setting of fixed or variable direction of rotation, rotational speed and phase position in relation to a reference eccentric for each respective eccentric. The control and monitoring system (5) receives, via an output signal (9) from the angle sensor (12), information about the angle position of the eccentric and calculates the direction of rotation, speed of rotation and phase position of the eccentric and by means of the signal (7) regulates the correct direction of rotation, speed of rotation and phase position through a signal (8) to the drive device (11) of the respective eccentric.

3. Device according to requirement 1 and 2 characterised by the superior control device (4) receiving information about the parameters for a specific force vector diagram through a control signal (6) and determining the direction of rotation, speed of rotation and phase position of the eccentrics, the values of which are transmitted to all of the control and monitoring systems (5) through the signal (7).

4. Device according to requirements 1–3 characterised by the mass centre of the eccentrics (10) having approximately the same geometric axis of rotation (17) and that the mass centre of the eccentrics (10) rotates in approximately the same geometric plane (18).

Figure 1

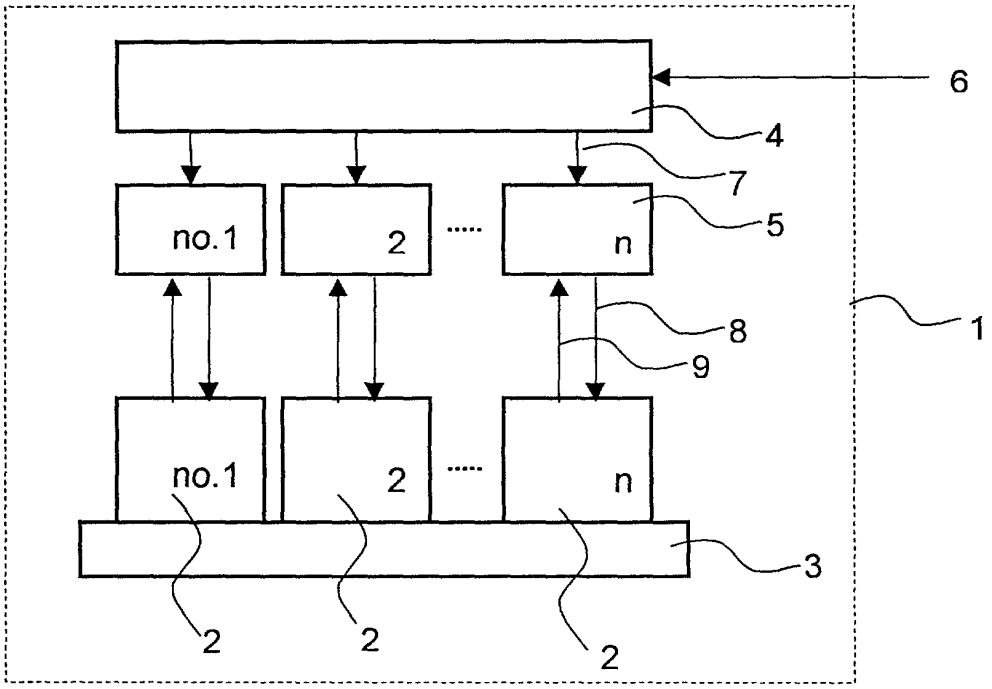
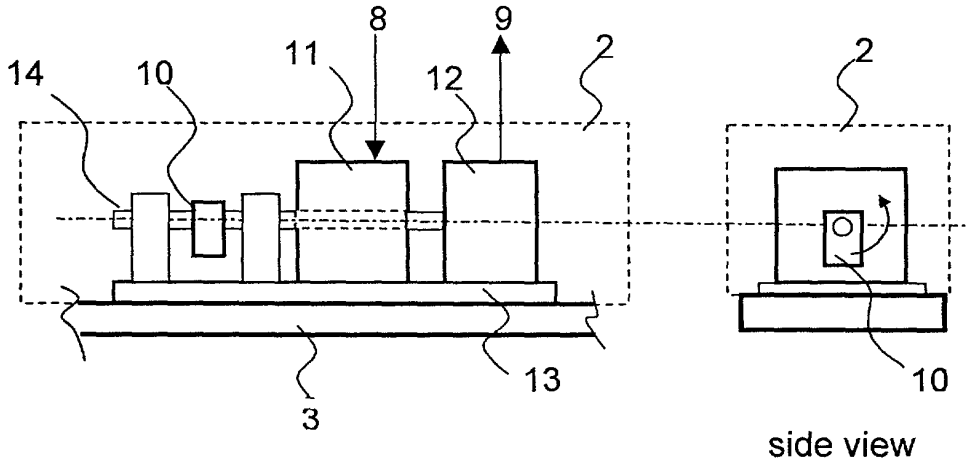


Figure 2



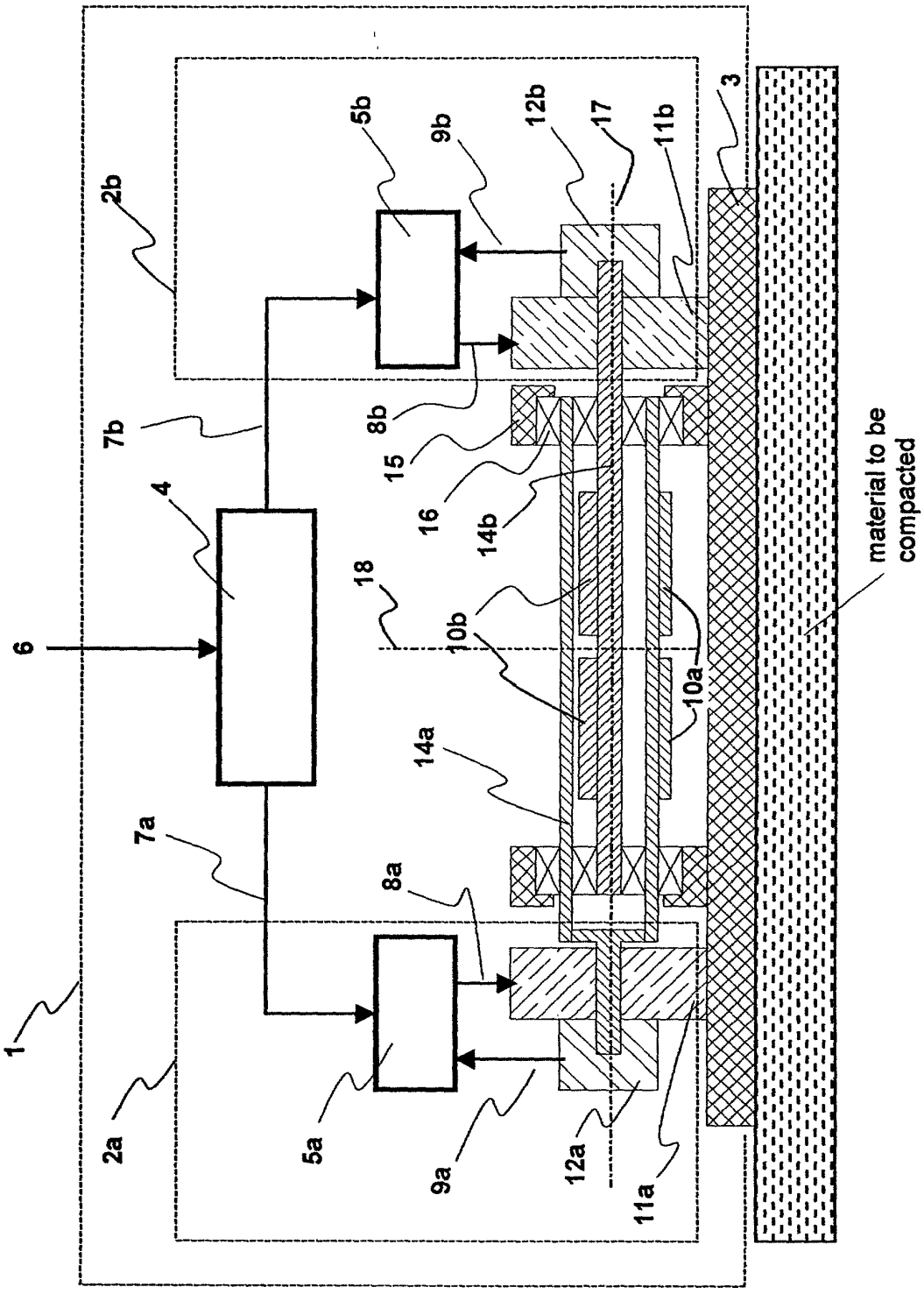


Figure 3

Figure 4

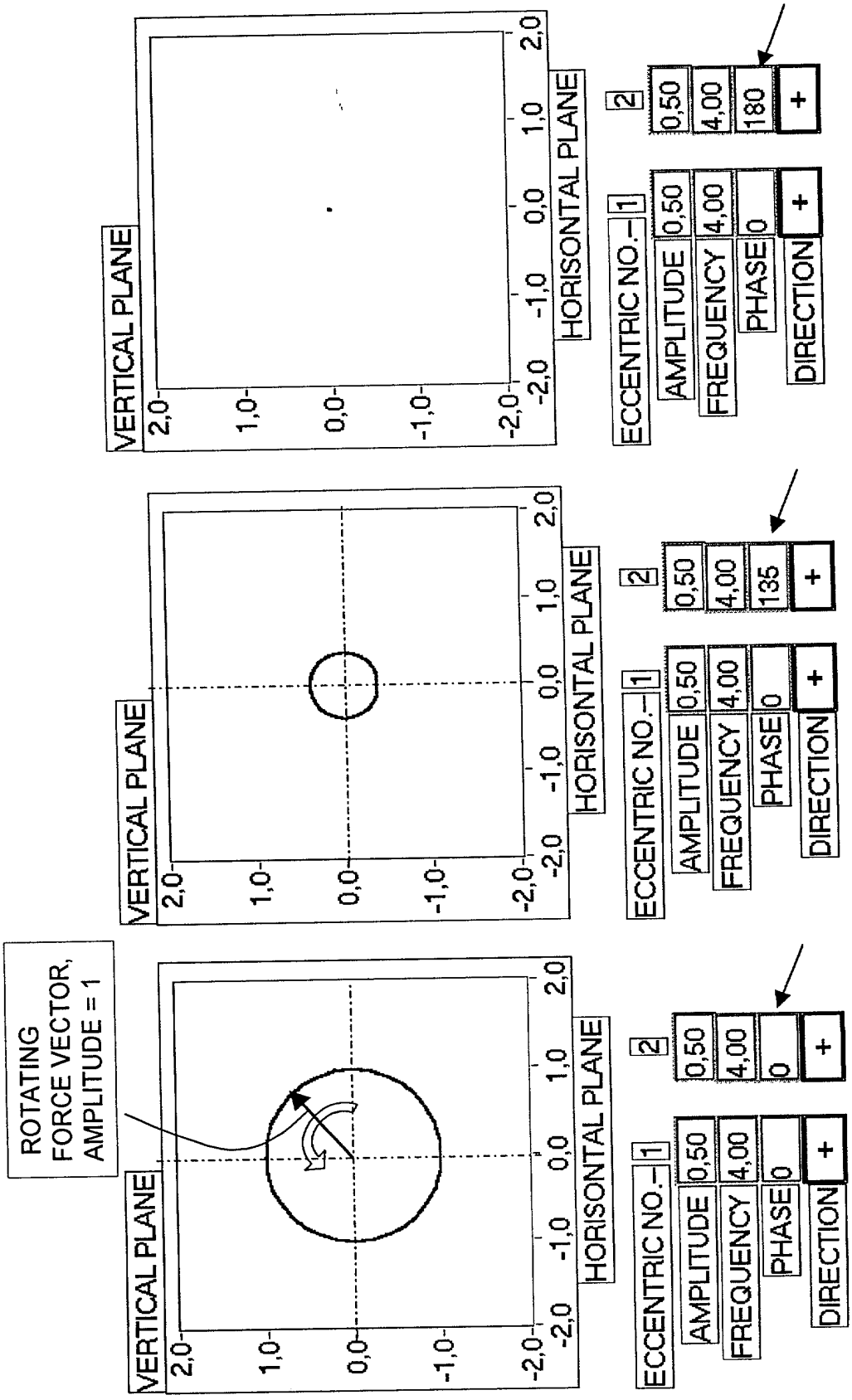


Figure 5

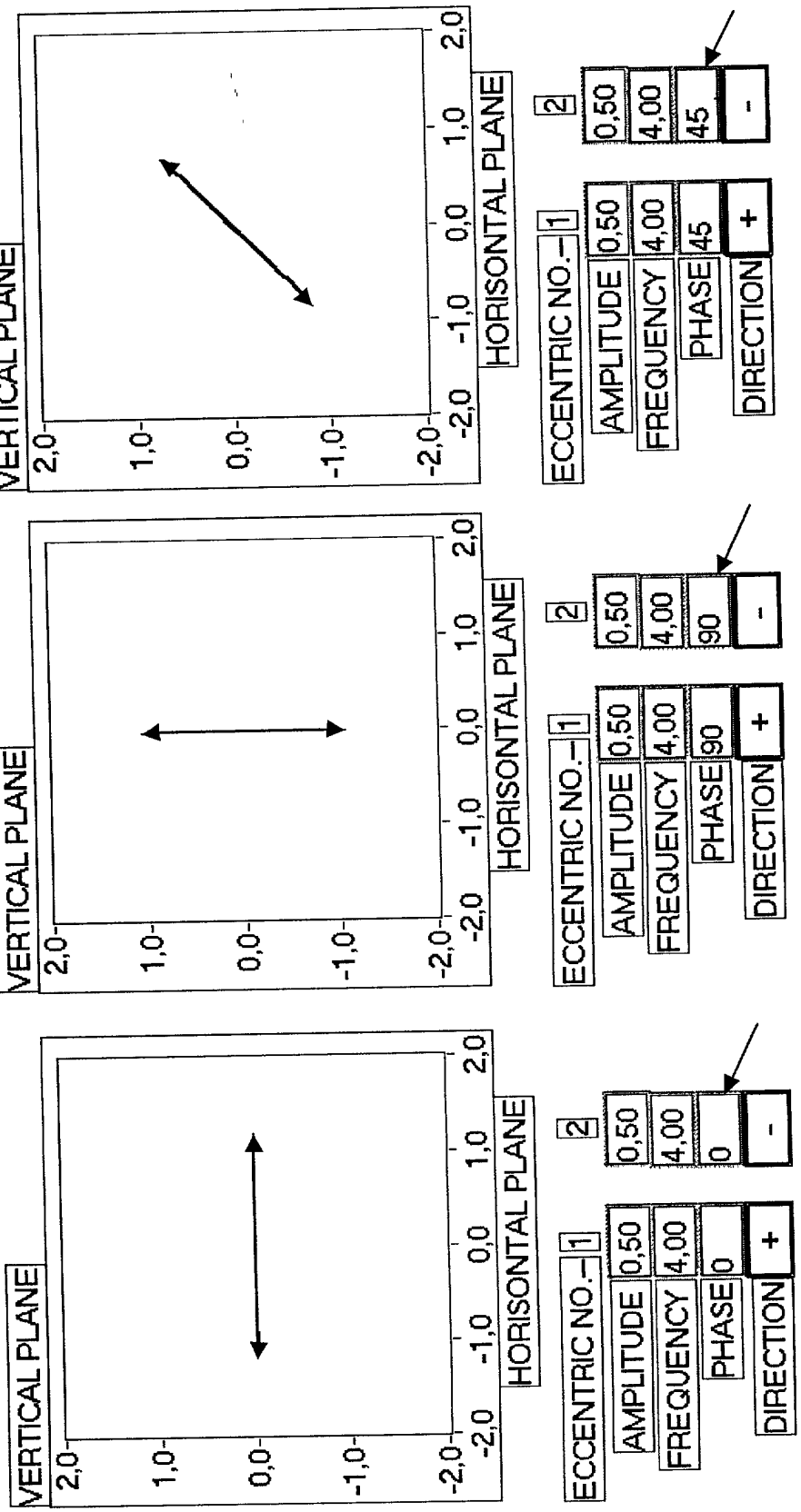


Figure 6

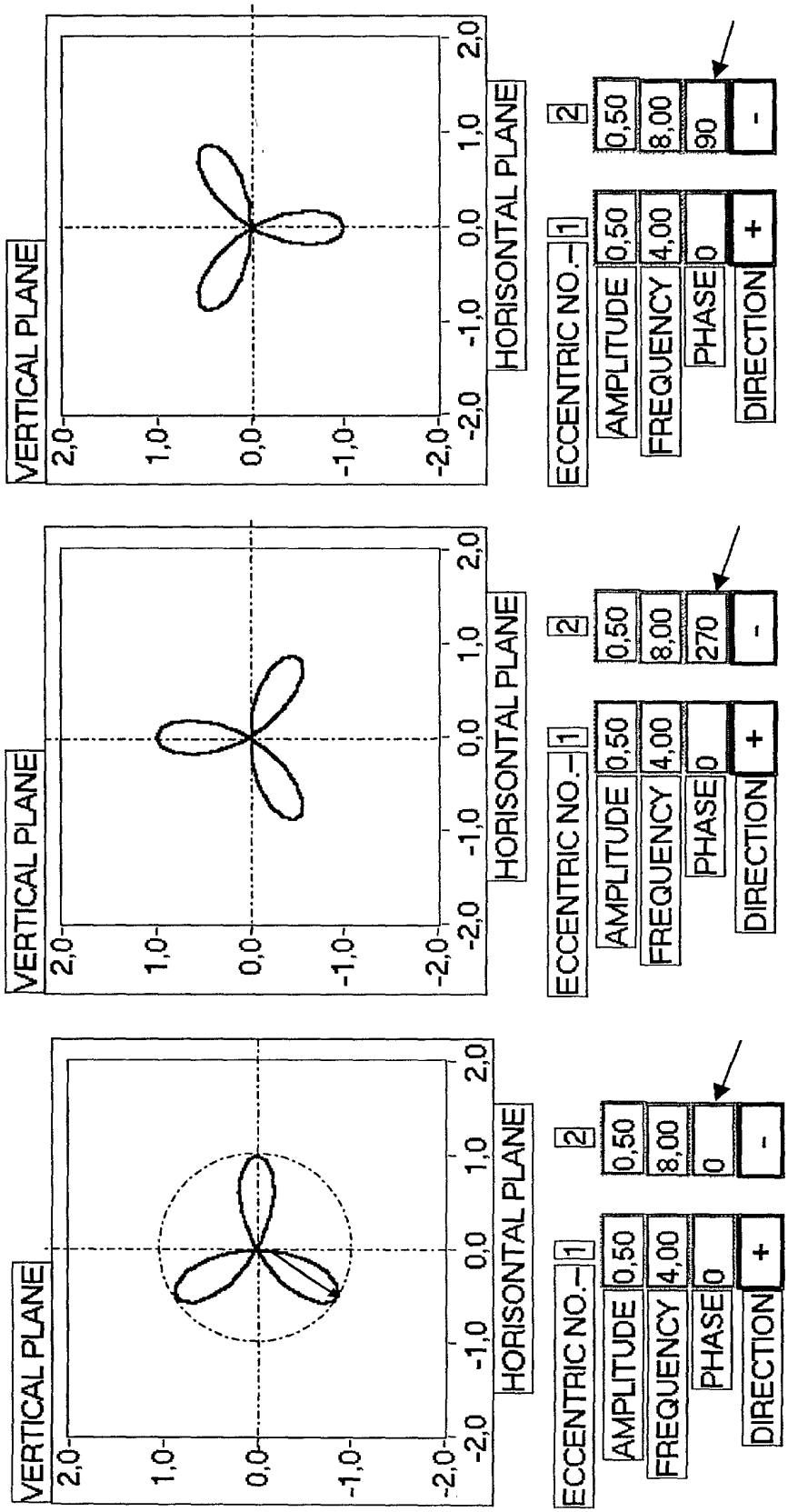
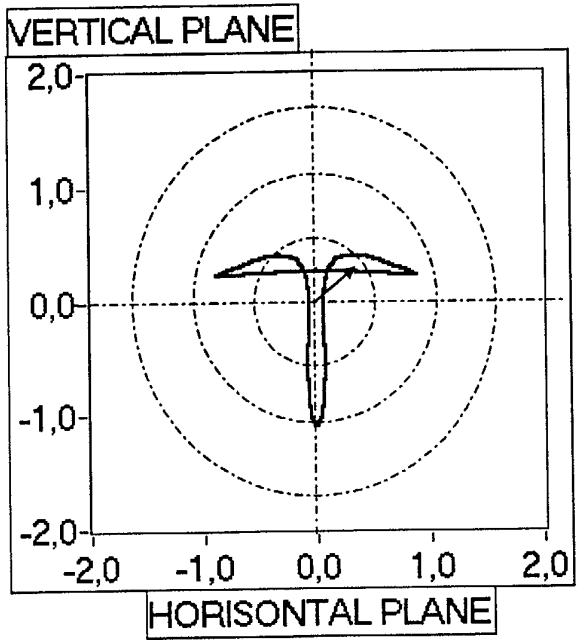
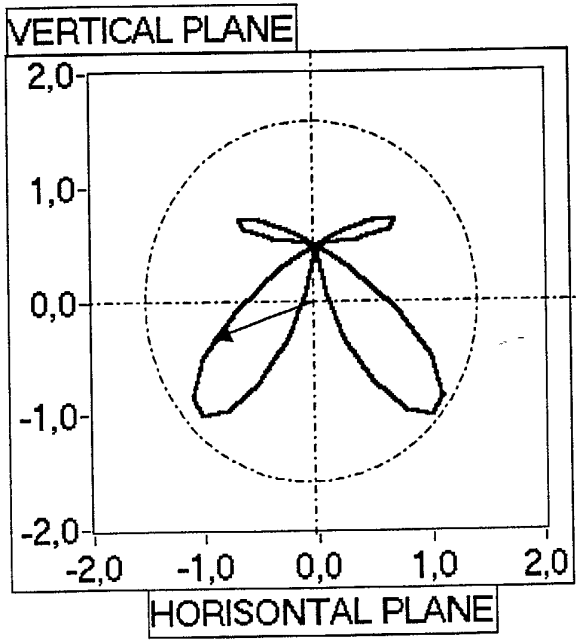


Figure 7A



ECCENTRIC NO.–	1	2	3
AMPLITUDE	0,50	0,41	0,18
FREQUENCY	4,00	8,00	12,00
PHASE	0	90	180
DIRECTION	-	+	-

Figure 7B



ECCENTRIC NO.–	1	2	3
AMPLITUDE	0,50	0,50	0,50
FREQUENCY	4,00	8,00	12,00
PHASE	0	270	0
DIRECTION	-	+	-

Attorney Docket No. ULFIA-1

Declaration and Power of Attorney for National Stage of PCT Patent Application

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: Device for Generating Mechanical Vibration, the specification of which was filed as PCT International Application number PCT/SE 00/00487 on March 13, 2000.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
9900990-4	Sweden	18 Mar 99	X	___
(Number)	(Country)	Date Filed	Yes	No

As a named inventor, I hereby appoint the following attorney to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Walter Ottesen
Reg. No. 25,544

Direct all telephone calls to Walter Ottesen at telephone no. (301) 869-8950 and address all correspondence to:

Walter Ottesen
Patent Attorney
P.O. Box 4026
Gaithersburg, Maryland 20885-4026

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

Full name of sole or first inventor, if any Ulf Bertil Andersson

Inventor's signature Ulf Andersson Date September 13, 2001

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